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REALIZING NETWORK-CENTRIC WARFARE:
THE CULTURAL, ORGANIZATIONAL, AND HUMAN BARRIERS

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Executive Summary

Title: Realizing Network-Centric Warfare: The Cultural, Organizational, and Human Barriers

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Thesis: Despite significant DOD initiatives to implement the NCW concept, there remains a lack of adequate focus on evolving the cultural, organizational, and human components of NCW with the fielding of advanced information technology.

Discussion: The Department of Defense (DOD) transformation to NCW has lacked adequate focus on many social and organizational issues. Most of the DOD's effort has been in acquiring technical solutions without adequate regard for integration with the people, institutions, and processes. NCW's purpose is to enhance the decision-making process at all levels throughout the battlespace. Decision-making is a human behavior only "enabled" by information technology (IT). IT does not always set the stage for the level of awareness required for making effective decisions. The human aspects of implementing NCW still need considerable work. This subject is of significant importance due to its sweeping implementation throughout the DOD, interagency, and numerous U.S. allied armed forces.

Conclusion: Adapting the U.S. Military to harness the benefits of the "information age" is more of a challenge than originally thought by NCW concept developers and senior leaders. Implementing NCW presents significant challenges due to the complex relationships between warfighters, technology, and the organizational structure. Early efforts to implement NCW have allowed technological acquisitions to drive the process. History tells us that "transformation" involves much more than technological or material solutions. The DOD recognizes that corresponding changes to doctrine, organization, training, materials, leadership, personnel, and facilities (DOTMLPF) are required to manage any pursuit of increased capabilities. Without fully integrating technology with changes across the DOTMLPF, the U.S. Military risks degrading its ability to achieve decisive victory in future operations. The 21st century U.S. Military must be organized to handle the full range of military operations. In order to successfully employ advanced technologies in "crisis response and limited contingency operations" and "major operations and campaigns," the U.S. Military must reach new levels of flexibility and adaptability. Most importantly, much more focus needs to be applied to understanding the human component of NCW, since warfighting and decision-making are mostly about human behavior. Finally, future success of implementing NCW will hinge on the DOD putting more effort and funding into a more comprehensive and systematic transformation to include integrating efforts with the interagency and coalition forces. These efforts need to place less emphasis on developing and acquiring new technologies and more emphasis on developing the people and processes.

Table of Contents

DISCLAIMER.....	i
Preface.....	ii
Introduction.....	1
The Information Age - Why Transform the Military?.....	2
Cultural Challenges to Transformation	6
Organizational Challenges to NCW.....	9
Developing NCW Processes for an Information Environment	10
System Complexity Brings a “Cost”	11
Blurring the Levels of Command	12
Rethinking the Command and Control Structure.....	13
The Human Dimension Challenges to NCW	16
Engaging Innovation through Changes across the DOTMLPF	18
Conclusion	21
Appendix 1: Network-Centric Warfare: Domains of Conflict ⁵⁹	22
Appendix 2: Network-Centric Operations Value Chain ⁶⁰	23
Notes	24
Bibliography.....	28

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Preface

The following thesis emerges from my experience as a Marine Aviation Command and Control Officer during the current Marine Aviation C2 transformation. With equipment modernization and emerging concepts, such as network-centric warfare (NCW), fighting forces pursue unprecedented warfighting capabilities in an increasingly complex operating environment. An analysis of this transformation points to the requirement for activities on all levels to participate in implementing changes to the doctrine, organization, training, materials, leadership, personnel, and facilities (DOTMLPF). This study further identifies enhancing our leader's decision-making through engaging the cultural, organizational, and human factors of NCW. In the end, it attempts to bring to light the importance of addressing the challenges of NCW that have been overshadowed by the search for technological solutions. This thesis represents the culmination of a year of learning that would not have been possible without LtCol B.J. Payne, LtCol Peter Yeager, Dr. Eric Shibuya, Dr. Paul Gelpi, and my mentor Dr. Charles McKenna.

Information is a source of learning. But unless it is organized, processed, and available to the right people in a format for decision-making, it is a burden, not a benefit.¹

-C. William Pollard

Introduction

Throughout its history, the U.S. military has embraced transformation in an attempt to gain a warfighting advantage over its adversaries. Changes in military technology, concepts, and organization have usually come in conjunction with changes to our nation's social, economic, and political structure. These great periods of change include the "agricultural age," "industrial age," and the current "information age." With the advent of the information age, technology has both allowed and demanded greater global capacities to share and access information. The U.S. Department of Defense (DOD) developed the Network-Centric Warfare (NCW) concept to translate the military's information advantage into mission success. The Office of Force Transformation points out in *The Implementation of Network-Centric Warfare* that "NCW seeks to translate information advantage into combat power by effectively linking friendly forces from within the battlespace, providing a much improved shared awareness of situation, enabling more rapid and effective decision-making at all levels of military operations, and thereby allowing for increased speed of execution."² Future information technology will undoubtedly promote a more robust information network in support of battlefield operations. However, successful implementation of the NCW concept hinges upon effective decision-making at all levels, an intensely human process. Despite significant DOD initiatives to implement the NCW concept, there remains a lack of adequate focus on evolving the cultural, organizational, and human components of NCW with the fielding of advanced information technology.

According to the late Vice Admiral Arthur Cebrowski USN (Ret), the former Director of the Office of Force Transformation (OFT), "Implementation of NCW must look beyond

acquisition of technological enablers, to individual and organizational behavior, e.g., organizational structure, processes, tactics, and the way choices are made.”³ Information technology acquisition within the DOD has significantly outpaced and been disconnected from complementary changes to culture, organization, and human behavior characteristics. The DOD must, therefore, harness a holistic approach to NCW to ensure the people, processes, and technology optimizes the decision-making process and execution of the future networked forces.

While there are many interdependent factors involved in NCW operations, this paper will focus upon the cultural, organizational, and human challenges that need to be addressed in order for transformation to yield the most from integrating new information technologies. These changes need to take place within all areas that define our force’s ability to conduct operations. The U.S. military recognizes doctrine, organization, training, leadership, materials, personnel, and facilities (DOTMLPF) as its fundamental capability areas within which force transformation is conducted. True transformation of the U.S. Military requires the DOD to establish both a firm unity of command and unity of effort of its services to drive changes in all of these areas.

The Information Age - Why Transform the Military?

Dr. Hans Binnendijk, Founding Director of the Center for Technology and National Security Policy at the National Defense University, offers insight into the current military transformation and the associated risks:

Military transformation is the act of creating and harnessing a revolution in military affairs. It requires developing new technologies, operational concepts, and organizational structures to conduct war in dramatically new ways. The United States is undertaking such transformation to tackle its 21st century missions. A properly transformed military can develop significant advantages over a potential enemy. But the process also introduces risks that, if not properly managed, could dangerously undermine military capability.⁴

The prevailing requirement for the DOD's current transformation is the nation's transition from the industrial age to the information age. The advancement of information technology now allows forces the ability to access and share information in unprecedented ways, thus favorably impacting efficiencies, speed, and tempo of military operations. In the mid-1990's, Joint Vision 2010 and 2020 were developed by the Joint Chiefs of Staff (JCS) to guide the military's transition to information-based warfare. Both documents stressed speed and information over mobilization and mass.⁵ Through the 2001 *Quadrennial Defense Review Report*, the U.S. military and defense agencies were directed to transform to meet the challenges of the 21st century. In addition to responding to the call of information dominance, 21st century transformation relies upon creating efficiencies through emphasizing joint warfare and promoting mission flexibility through expeditionary forces.

NCW is the concept that emerged to create a warfighting advantage from the advances of information technology. This emergence was designed to take the place of platform-centric warfare that limited the battlespace situational awareness of warfighters. Platform-centric warfare focused on individual weapons systems rather than their integrated and synergistic effects on the battlefield. Dr. Thomas P. Rona likened NCW to an "extended weapons system" that allowed geographically separated decision-makers, weapons platforms, and sensors to be linked through the EM spectrum.⁶ Admiral William A. Owens and Vice Admiral Arthur K. Cebrowski further described NCW as a "system of systems," networking interoperable systems and eliminating stove-piped systems.⁷ Through the U.S. DOD's Global Information Grid (GIG), U.S. Military service components and defense agencies are provided a globally integrated network of people, processes, and systems to enable NCW.

As the DOD continues to develop and implement NCW, each service component and many allied forces strive to implement NCW across their mission areas and battlespace. Each has adopted a separate name to differentiate their development of people, processes and technology toward the DOD directed NCW concept. The Army's contribution to the DOD GIG is LandWarNet (LWN); The Navy and Marine Corps' is FORCEnet; The Air Force's is C2 Constellation. Multiple North Atlantic Treaty Organization (NATO) members have related initiatives to NCW, such as the United Kingdom's Network Enabled Capability (NEC), Australia's Ubiquitous Command and Control (UC2), and Sweden's Network Based Defence (NBD). Mandeles states in *The Future of War: Organizations as Weapons*, "Although each service will implement it differently, the network-centric operational concept is likely to be at the core of U.S. military planning and acquisition in the 21st century."⁸ However, the lack of central management has yielded a range of future problems, including interoperability of systems, doctrine, and procedures. These service-centric solutions and commercial technological solutions are driving the implementation of NCW without central management by designated joint and coalition developmental commands. NCW joint, coalition, and service doctrine and mature tactics, techniques, and procedures (TTPs) must evolve with technological capabilities to facilitate effective conduct of NCW during combined military operations.⁹

In *Defense Transformation: To What, For What?*, Kevin Reynolds states, "NCW translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace."¹⁰ The creation of combat power by making decisions in a more information dominant environment is not an intuitive process. David S. Alberts describes the NCW environment as four interconnected domains translating information superiority into decision superiority and decisive effects (see Appendix 1: NCW Domains of Conflict). The first

domain is the “Physical Domain” where military forces take action, maneuver, strike, and defend themselves. Next, the “Information Domain” is the communication medium to create, manipulate, and share information. Third, the “Cognitive Domain” represents where warfighters translate information into understanding and decisions. It resides in the minds of the warfighters who interact within the network. Lastly, the “Social Domain” intersects the other three domains. The “Social Domain” represents where shared awareness and collaborated decisions take place.¹¹

NCW is really about human and organizational behavior enabled by a robustly networked environment to share information. The information technology and networking tools will not instantly produce desirable solutions to complex battlefield problems. The solutions, ultimately, come from the warfighter’s cognitive ability to process all available information and to make sound and reasonable judgments. The warfighter must have access to all relevant information and knowledge pertaining to the issues and problems they face. Improving the collective battlefield situational awareness requires a complex networking of people, interaction, and relationships. Lieutenant General Paul Van Riper, in Worley’s *Shaping U.S. Military Forces: Revolution or Relevance in a Post-Cold War World*, emphasizes less investment in technology and more in the knowledge and skill of decision-makers at all levels.¹² Through greater understanding of the cognitive and social domains of NCW, superior military capabilities can be employed in pursuit of decisive victories.

Cultural Challenges to Transformation

The military organization is no different from any other in society in that future success depends upon innovation to maintain a competitive edge. The military culture is vitally important to breeding innovation and institutionalizing change. D. Robert Worley explains a military culture that is conducive to innovation:

Innovation is either promoted or inhibited by military culture. A military culture of innovation is characterized by focusing on problems, asking the right questions, challenging cherished beliefs and orthodoxy, and honestly interpreting data provided by history and experimentation.¹³

Airpower innovation between the Vietnam War and Desert Storm represents successful transformation enabled by changes in the military culture. American airpower during Vietnam was largely viewed as a failure for many reasons, including the misapplication of new systems, such as laser-guided bombs (LGBs) and improved Electronic Warfare (EW).¹⁴ Despite the technological edge in airpower, American forces suffered from ineffective training and tactics. The two decades between Vietnam and Desert Storm saw a fundamental shift in the application of airpower. From 1972 to 1991, technology, training, and tactics continued to improve, ultimately providing battlefield commanders unprecedented effects from airpower. The application of airpower in the 1991 Gulf War eliminated the previous belief that American airpower was limited to a supporting role behind armor and infantry.¹⁵ Airpower proved to be a highly effective tactical, combined arms platform, as well as one with strategic capabilities. This example highlights that the transformation process will take time to mature; the problem must be the focus for innovation; and the military culture has to be flexible and accepting of positive change. These conditions could not be more relevant in the current transformation, because NCW's implementation will transform the entire DOD. Warfighter and service loyalties to traditional ways of doing business and the view that NCW is a preordained technological

solution contribute to an inhospitable culture.¹⁶ Introducing radically different operational concepts to military organizations is more difficult, because services are resistant to the formation of new organizations, roles, and missions. Employment of new technologies within existing intellectual and social skills is a much easier scenario to which militaries can adapt. However, when new intellectual and social skills are required to support technology employment, the transformation becomes significantly more difficult.¹⁷ Unfortunately, NCW requires more special technical skills, social skills, tactical proficiency, and mental agility of all military members involved in network warfare operations.

The emergence of the information age and implementation of NCW presents challenges to the existing command and control relationships of military services despite the promise of greater independence of operations. By and large, military services attempt to push tactical decision-making to leaders at the lowest levels of command in order to deal with rapidly changing battlefield conditions. Within the Marine Corps, decentralized decision-making is a common thread among all operational concepts (e.g., Expeditionary Maneuver Warfare, Operational Maneuver from the Sea, Ship to Objective Maneuver, and Distributed Operations). NCW threatens decentralized decision-making for numerous reasons. First of all, NCW provides leaders at all levels of command (e.g., tactical, operational, and strategic) the ability to access, manipulate, and share large amounts of battlefield information. This synchronized common operational picture (COP) enables centralized decision-making at higher levels of remotely located commands. The danger manifested in senior decision-makers becoming too involved in tactical decisions is that political and military objectives become intertwined.¹⁸ When this happens, senior leaders making tactical decisions may lose focus on the operational or strategic objectives and slow down the tactical decision-making process. Additionally, as more

information is available, the urge and need for greater fidelity and certainty emerges. The pursuit of certainty threatens the tradition of initiative and independent operations in our military services, especially the Navy.¹⁹ Rear Admiral William J. Holland highlights the following cultural conflict with submarine operations:

Holland noted that key elements of NCW operations-e.g., continuous communications connectivity to transmit large amounts of data and pooling weapons assets across platforms is contrary to a submarine's defining strengths, stealth and independent operations. To counter this incongruity, the Navy will have to devise new routines and processes to incorporate the submarine into network-centric operations or accept that the submarine will no longer act independently.²⁰

Limiting initiative and the ability of commands to conduct independent operations could reduce combat effectiveness at a time that speed and tempo of operations is imperative. The 21st century will provide increasingly challenging situations to our armed forces in the conduct of "crisis response and limited contingency operations." These smaller scale contingencies yield less certainty than "major operations and campaigns," thus they stress understanding human behavior over technological solutions. Finally, leaders and command posts at all levels are at risk of information overload and distraction from their principal assigned tasks. The key for command and control is striking a balance between interdependence and independence and the ability to operate successfully in an environment with a degree of uncertainty.²¹

A price of conducting NCW, especially with interagency and coalition partners, is the increased availability of information to the public.²² The information age and NCW allow the public unprecedented media coverage of military operations and associated decisions. This phenomenon lends itself to immediate public awareness and scrutiny, as well as indirectly decreasing the time the leader has to make a decision. Private news media organizations and satellite communications make it more difficult for military leaders to affect Information

Operations (IO).²³ NCW has IO effects that reach far beyond the eyes and ears of the intended warfighter. With the sheer volume of information, numerous methods of delivery, and subjectivity of content, gaining and maintaining a friendly IO advantage over the adversary is a monumental task for campaign success.

Organizational Challenges to NCW

Marine Corps Doctrinal Publication (MCDP) 6 identifies command and control (C2) as the single most important warfighting function, since it is essential to all other warfighting functions.²⁴ A key component of C2 is the proper arrangement of personnel, equipment, and facilities to enable the commander's decision-making and battlefield influence. Although the information age is creating more adaptable and flexible organizations, proper design of the command and control system is required to maximize the benefits of NCW. According to Alberts, Garstka, and Stein, "New approaches to command and new command arrangements are needed to effectively flatten hierarchies, free information flow (not orders) from the chain of command, and enable the enterprise to increase the speed of command to lock out adversarial options and achieve option dominance."²⁵ This new approach to command and control must ensure future organizational structures take into account how personnel process information and the establishment of command and control relationships that are responsive to the commander's leadership. As Mandeles points out, "Organization is an important consideration for analysis of future military operations because it provides the means for people to exercise influence and authority over others and determines the information environment and channels for individual decision-making."²⁶ The effort to transform existing command and control systems to optimize NCW must focus on creating an environment conducive to information flow, supporting the

commander's authority and influence, and establishing organizational structures with enhanced coordination and cooperation capabilities.

Developing NCW Processes for an Information Environment

Obtaining information dominance on the battlefield cannot be achieved solely with technological solutions. The environment in which information is shared must be changed through adapting new processes to optimize NCW benefits. The following four tenets of NCW outline how a technologically networked force achieves a warfighting advantage:

- 1) Robustly networked force improves information sharing.
- 2) Information sharing enhances quality of information and shared situational awareness.
- 3) Shared situational awareness enables collaboration and self-synchronization, and enhances sustainability and speed of command.
- 4) These, in turn, dramatically increase mission effectiveness (see Appendix 2: NCO Value Chain).²⁷

Ensuring the widest possible distribution of information is the key to enabling NCW. No longer can information be stove-piped, but must transcend all functional areas (i.e., operations, intelligence, logistics, etc.) and processes (e.g., organizing, deploying, employing, and sustaining).²⁸ This includes networking forces on all levels of command: tactical, operational, and strategic. NCW tenet #3 represents the most difficult aspect of NCW, because it relies upon the warfighter's cognitive and human interaction capabilities to support collaborative decision-making. Common understanding of the commander's intent at all levels is at the forefront of achieving self-synchronization throughout the networked force. Another piece to ensuring an information environment for NCW is maintaining interoperable organizations, both technically and procedurally, at all levels of command. In order to maximize lethality, survivability, and responsiveness of the force, Network-centric operations need to be conducted by organizations at

the lowest possible level, which requires them have increased capabilities to handle operations normally conducted by a higher level organization.²⁹ A higher level of situational awareness on the battlefield is only an advantage if units have the ability to act on the information more quickly than their enemy.

New processes designed for NCW implementation face numerous challenges that must be put to the test in robust training and evaluation exercises. No matter what degree of information dominance, the friction of war cannot be eliminated. According to Michael Handel, information and intelligence will never be completely accurate, so organizations must be capable of operating within the fog of war.³⁰ How decision-makers handle stressful situations given new organizational processes requires additional research and development. For instance, how will decision makers handle incomplete information, inaccurate information, information overload, network system failures, interoperability issues, and fatigue, etc.? The effectiveness of NCW hinges upon new organizational processes and steps that are habitual and routine to ensure adherence during the most stressful battlefield conditions. At times, increased operational tempo will degrade the ability to identify information deficiencies. Organizations at all levels are susceptible to these challenges and especially as networked systems and processes evolve.

System Complexity Brings a “Cost”

The information environment faces additional challenges due to the complexity of the systems enabling NCW. For instance, Mandeles believes that the advanced C4ISR technologies will require more specialized personnel to monitor and process information making it more difficult to coordinate and interact within the organization.³¹ Future organizations operating under the NCW concept will manage a much larger volume of information, thus requiring a vast

increase in the number of command and control nodes. Mandeles further expects the stability and predictability of the system to suffer due to a greater interdependence of components within the system.³² Organizations must be prepared to execute operations in the event that command situational awareness is degraded due to system failures. Finally, a networked force that can create battlefield situational awareness at agencies spread over great distances creates a challenge to generating and sustaining operational tempo. The more layers of monitoring and decision-making injected at higher levels of command the slower the execution. In 1999, Operation Allied Force illustrated how organizational structure can decrease operational effectiveness. Mandeles explains that the targeting process during Operation Allied Force was complicated and resulted in slow transmission of approved targets to "shooters." Through video teleconference and secure communications, lawyers, air campaign planners, ISR organizations, and commanders spread throughout Europe (e.g., Germany, Italy, England, and Belgium) collaborated during the target development and review process. The enabling technologies allowed for longer, more intense debate concerning some operational issues, which reduced some advantages of NCW.³³

Blurring the Levels of Command

NCW implementation is challenging the power and authority of leaders in the existing top-down hierarchical command relationships. The emergence of networks requires distribution of power among more independent and interdependent entities. The current top-down philosophy based on central authority does not capitalize on an information dominant society. David J. Schmidtchen points out that "Innovation is driving a requirement for leaders on the edges rather than center . . . Fast and innovative responses to threats require organization decentralization to local leaders to make strategic decisions."³⁴ Establishing trust is imperative among personnel

operating in widely dispersed locations conducting network-centric operations. A necessary precondition to self-synchronization is trust in the information, systems, leaders, and followers.³⁵ However, the ever-increasing knowledge requirements by all leaders permits unprecedented battlefield situational awareness. Scrutiny of leader's battlefield decisions is intensified by increased battlefield situational awareness at all levels and the ability to quickly communicate with widely dispersed civilian and military leaders.³⁶ This has ramifications for leaders at higher levels who depart the strategic and operational level and delve into tactical level decisions. The associated risk involves inadequate decisions by leaders furthest removed from the battlefield and source of the information. The impact of advanced information technology on command relationships must be closely studied to ensure proper task delegation and promotion of initiative.³⁷ The strength of NCW lies in an environment rich in human cooperation, capabilities, and motivation towards a common objective.

Rethinking the Command and Control Structure

The NCW concept and enemy capabilities determine the future organizational structure of military commands. The organizational structure is greatly influenced by NCW's widespread networking of sensors, decision makers, and weapons systems. Unless the relationship and coordination issues are resolved, the introduction of complex information processing, communication, and sensor equipment to organizations may inhibit delivering timely, accurate, and reliable information to the appropriate warfighters.³⁸ Conventional and non-conventional enemy forces have different centers of gravity and critical vulnerabilities. Therefore, the type of military organizational structure adopted to degrade the enemy's ability to achieve mission accomplishment may not be ideal for combating both types of enemy forces. Implementation of

effective NCW organizational structures depends upon the establishment and constant reevaluation of the appropriate hierarchy, assignment of tasks, and mission factors.³⁹ There may be times when different types of command and control structures need to interact harmoniously on the battlefield.⁴⁰ An NCW organizational structure that can support assured situational awareness, manageable information flow, and flexible operations is the goal. Mark D. Mandeles provides the following thoughts on future organizational structure:

Waging warfare with modern communications, sensors, and computing equipment, complex weapons systems, and long range-precision munitions requires organizational forms that (1) conserve the attention of senior leaders, (2) do not overwhelm the average user's computational and calculation abilities, and (3) respond well to uncertainty and rapid changes.⁴¹

Interagency and coalition coordination requirements create another challenge to adopting organizational structures for NCW operations. Different types of organizational structures are appropriate for the desired level of authority, flexibility, and confidence. Mandeles suggests three organizational models with distinct leader – subordinate relationships, tasks, responsibilities, and levels of interaction between entities.

The first organizational model is “tight coupling.” Currently, tight coupling represents the most prevalent form of command and control in military operations. The foundation of tight coupling is the traditional hierarchical top-down organizational form. As Mandeles points out, “In a tightly coupled organization, the arrangement of decision rules, routines, or SOPs to coordinate and integrate actions represents knowledge about the environment and problems the organization confronts.”⁴² The organization that utilizes this form of command and control plans and executes sequentially. This organization is “programmed” or driven by the commander’s intent. Commanders prefer tight coupling, because they have more influence over their subordinate units with less direct communication due to established formal procedures. The

effects of the information age and low intensity conflicts are invalidating many situations in which tightly coupled organizations can succeed due to increased operational tempo. The ability to execute a variety of courses of action is essential to operating in today's warfare environment. Programmed decision-making in this chaotic environment will leave the military well short of mission success in many situations. However, there is a place for tight coupling of some processes the organization follows. For instance, operations involving nuclear weapons delivery or casualty evacuation (CASEVAC) would require very rigid procedures.

The second organizational structure suggested by Mandeles is "loosely coupled." The information age has prompted a replacement of the old command and control system. David Alberts tells us that current warfare requires a different approach to decision-making and the inclusion of dynamic planning into the current planning and execution process. The challenge to implementation of loosely coupled organizations is increasing organizational agility while limiting bureaucratic levels of command.⁴³ In contrast to tightly coupled organizations, loosely coupled organizations lack centralized control and preprogrammed actions. The goal is to push decision-making to the lowest levels and enhance independent operations. Loosely coupled organizations may seem to be disorganized, but maintain order as described by Mandeles:

Interaction and communication among components occur as needed and not as a result of commands or instructions. The roles of organizational components adjust on the basis of experience, and tasks are established by negotiation. The particular character of the matter at hand, rather than preset organizational arrangements, determines the components negotiating the tasks.⁴⁴

Time sensitive targeting (TST) is an example of situations in which loosely coupled organizations can succeed. Due to the information flow advantages of networked forces, lower levels of command can enjoy greater battlefield situational awareness and the ability to compress the fire support timeline of decide, detect, deliver, and assess (D3A). Target engagement does

not hinge on the targeting process filtering through higher levels of command for approval. Thus, military operations can have greater effects through increased speed, tempo, and timeliness of lethal and non-lethal fires. The challenge of loose coupling lies in the individual warfighter's ability to handle decentralized control. The commander's span of control will increase greatly due to the requirement for more redundant operating nodes within their networked forces. Additionally, warfighters at the lowest level of execution will have exponentially greater responsibilities with potential tactical, operational, and strategic ramifications. These decisions require seasoned individuals to synchronize tactical decisions with higher level objectives.

A third type of organizational structure that NCW will be called to support is the "informal" structure. Informal networks work within formal hierarchical structures to handle special, unanticipated, and short term situations. As illustrated by Mark Mandeles, aircraft carrier operations utilize informal networks to manage the complexities of carrier operations and minimize the hazards and risks associated. The range of possible errors and hazards is so wide that adaptive mechanisms are utilized to monitor operations and respond to emerging crises.⁴⁵ Informal networks are characterized by teams with highly specialized skill, knowledge, and training that support the commander's decision-making.⁴⁶ The key to success for organizations operating with this type of structure is that the informal and formal entities must maintain strong, trusting relationships in order to ensure the organization can deal with uncertainties.⁴⁷

The Human Dimension Challenges to NCW

MCDP 1-0 stresses that decision-making and warfighting are more about human behavior than the technology utilized. Decision-making and battlefield advantages are achieved by developing the warfighter's intangible characteristics while leveraging technology.⁴⁸ As

explained by David Schmidtchen, system fragility needs to be protected by the ability to regulate human behavior in networks.⁴⁹ Decision-making within a networked environment is a process that takes place through the cognitive and social domains. Therefore, a network enabled environment or “social order” must be able to translate individual behaviors into a collective outcome.⁵⁰

The success of networks relies upon their ability to create a stable and interactive environment to conduct military operations. Schmidtchen emphasizes that in order for the network to achieve collective success, two factors need to exist. First, components of the network must have confidence in one another (e.g., peers, subordinates, superiors, and technical systems). Second, driven by allegiance to the organization and underscored by shared values, norms, and standards, cooperation must pervade the network.⁵¹ For instance, during large force joint and combined operations, achieving the combatant commander’s vision depends upon the entire networked force operating with a unity of effort, unity of command, and mutual trust.

Information technologies have placed unprecedented demands on people’s cognitive and knowledge capabilities at all levels of the organization to operate in network-centric operations. First of all, achieving information dominance brings with it a propensity for information and sensory overload on the warfighter and the organization. Too much information and the inability to filter irrelevant information will slow down the decision-making process. To offset this condition, a more agile warfighter and more robust information management resources must exist. Next, higher operational tempos created by advances in information technology places more stress on the warfighter trying to keep up with the accelerated timeline. Mandeles explains that the presence of persistent stress promotes a degradation of decision-making and supports actions based on old habits instead of recent lessons learned.⁵² Third, superiors and subordinates

will be challenged by an increase in their span of control. Network-centric operations demand more flexible and agile units to conduct a wider range and volume of operations. This challenge leads to less time devoted to each task, while multi-tasking across the tactical, operational, and strategic levels of command. Finally, how will warfighters react when the nature of war (i.e., fog and friction) inevitably takes its toll on network-centric operations? With the influx of advanced command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) technology in combat designed to reduce ambiguities or unknowns on the battlefield, future warfighters may struggle with conducting operations using a degraded network.

Engaging Innovation through Changes across the DOTMLPF

The ability to harness innovation has always been a leadership challenge, but also an imperative to successful military operations. FMFM 1-0, *Leading Marines*, captured the essence of innovation as quoted by J. F. C. Fuller, “If we wish to think clearly, we must cease imitating; if we wish to cease imitating, we must make use of our imagination. We must train ourselves for the unexpected in place of training others for the cut and dried. Audacity, and not caution, must be our watchword.”⁵³

Proponents of NCW believe that increases in the robustness of networking command and control and warfighters will increase combat power through enhanced cooperative execution and self-synchronization. However, David Alberts offered the following word of caution:

Linking entities across the battlespace without the appropriate doctrine and organizational adaptations will not ensure an increase in military effectiveness. A decrease in effectiveness is likely if changes are not made to appropriate elements of DOTMLPF (e.g., doctrine, organization, training, materials, leadership, personnel, and facilities). The potential of NCW can only be captured by vigorously analyzing and experimenting network-centric operations throughout the DOD components.⁵⁴

Each and every component of DOTMLPF needs to evolve with NCW in order to ensure a complete, efficient, and effective transformation of our warfighting force. Strong leadership is the most vital component to this transformation process. Unity of command needs to be strictly enforced by the DOD to coordinate and control the separate service component initiatives within the joint force construct. Interoperability is imperative to NCW and will require military, coalition, and interagency forces to better coordinate their system acquisitions.⁵⁵ Additionally, starting with the DOD and trickling down to the lowest tactical levels, leaders need to embrace the technological changes, enforce required military institutional changes, and support requisite funding initiatives. Similarly, leaders need to invest more funding in the research and development of information management, study of NCW on organizations, and adapting new doctrine, tactics, techniques, and procedures (TTPs). A paucity of funds exists for these critical studies compared to funding for technological acquisitions. Finally, leaders must be developed to command and control in a dynamic information rich environment, including the ability to operate and employ advanced information systems.

The Defense Science Board's (DSB) April 2007 study identified the DOD's lack of focus on information management and recognition of combat information management as critical to military operations.⁵⁶ Personnel at all levels need to be developed and trained in information management in order to contribute to network-centric operations' success. This training should include knowledge of other services' and coalition force's capabilities and skill sets to enhance coordination. Additionally, the DSB task force recommended the creation of a new skill set, Information Specialists, to assist the commander in managing the battlefield's critical information flow requirements.⁵⁷ Indeed, no matter the extent of training, optimizing NCW relies upon cooperation and breaking down long standing cultural barriers. Specifically, transitioning

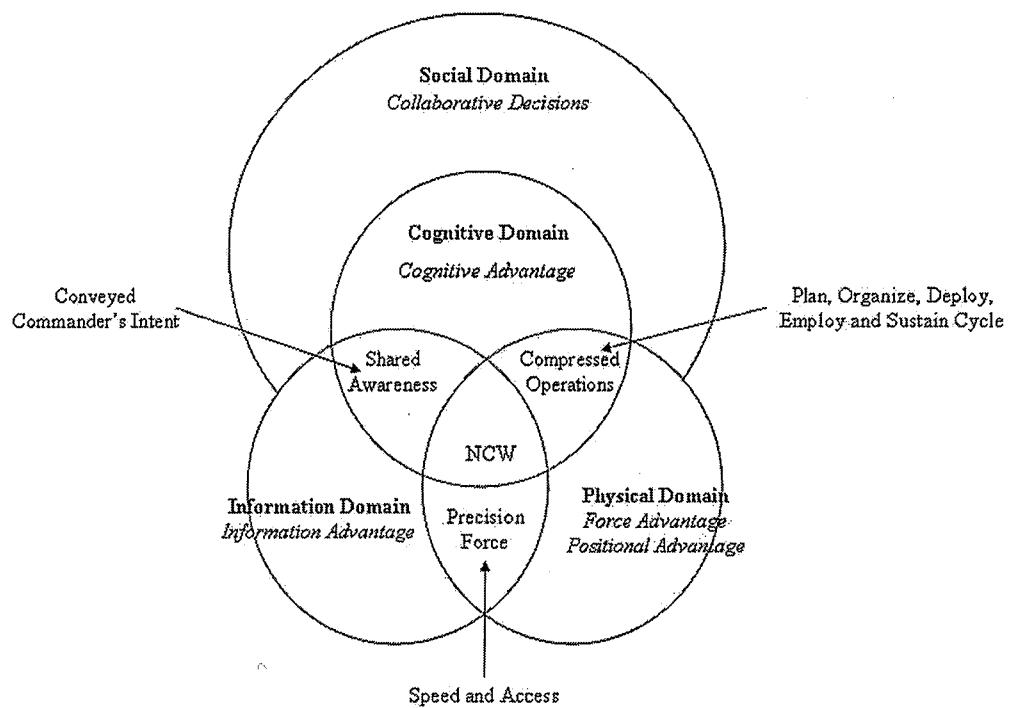
from the legacy vertical hierarchy to a flattened hierarchy will be difficult but essential to streamline information flow and decision-making.

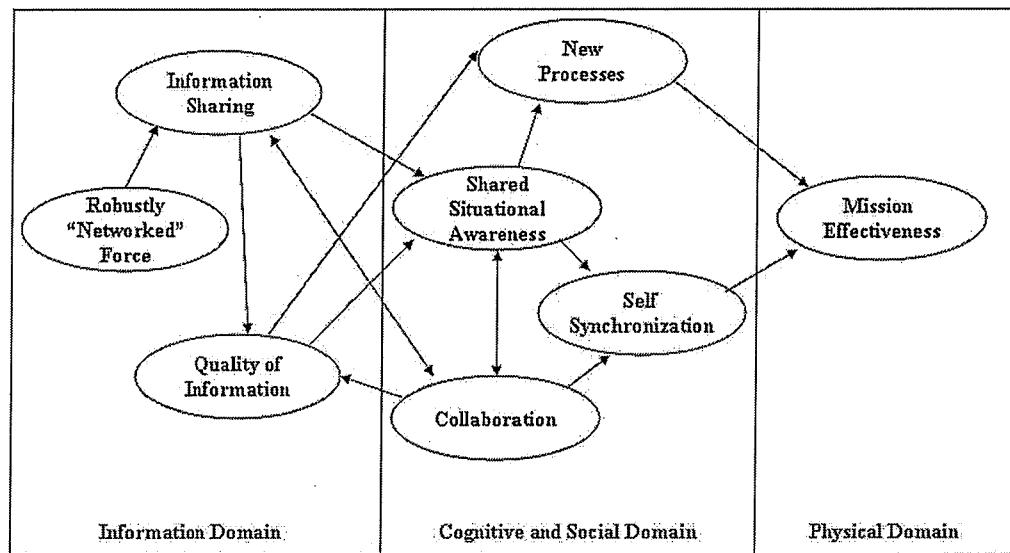
“Organization” and “doctrine,” including TTPs and Standard Operating Procedures (SOPs), need to be modified to sustain the agility and flexibility of the information dominant environment. Organizations need to focus on ways to build strong, seamless networks that can adapt to changing situations and still provide shared situational awareness throughout the battlefield. The commander’s command and control system must allow for adequate authority and influence over subordinate units, but at the same time provide subordinate units enough flexibility to conduct independent operations.

The success of network-centric operations requires intensive “training” and studies involving the military, coalition, and interagency. Peacetime training and real-world operations involving networked forces must be robust and demanding if they are to analyze information flow and decision-making capability. Warfare during the information age will require warfighters with a higher level of training, skill, and experience to enable the networked force. Achieving effective global network-centric operations is a monumental task that requires extensive governmental funding for training and studies. Additionally, studies need to be conducted on the technology-organizational-human interface in reference to the decision-making process under conditions of increased stress and fatigue.⁵⁸ The ensuing results can help match information technologies with the right doctrine, processes, and military organization in order to increase NCW combat success.

Conclusion

Adapting the U.S. Military to harness the benefits of the information age is more of a challenge than originally thought by NCW concept developers and senior leaders. A degree of disillusionment existed at the inception of NCW in that technology was believed to be the solution for enhanced battlefield situational awareness, more effective decision-making, and increased mission success. Coincidentally, early efforts to implement NCW have allowed technological acquisitions to drive the process. History tells us that transformation involves much more than technological solutions. NCW may be able to change the character of war, but the nature of war remains constant. Implementing NCW presents significant challenges due to the complex relationships between warfighters, technology, and the organizational structure. If technology is not fully integrated with changes across the DOTMLPF, mission accomplishment is at risk. Warfighters at all levels must understand that the transformation will take time to break long standing cultural barriers and create an environment for NCW to thrive. The 21st century U.S. Military must be organized to handle the full range of military operations. In order to successfully employ advanced technologies in “crisis response and limited contingency operations” and “major operations and campaigns,” the U.S. Military must reach new levels of flexibility and adaptability. Most importantly, much more focus needs to be applied to understanding the human component of NCW, since warfighting and decision-making are mostly about human behavior. Finally, future success of implementing NCW will hinge on the DOD putting more effort and funding into a more comprehensive and systematic transformation to include integrating efforts with the interagency and coalition forces. These efforts need to place less emphasis on developing and acquiring new technologies and more emphasis developing the people and processes.

Appendix 1: Network-Centric Warfare: Domains of Conflict⁵⁹

Appendix 2: Network-Centric Operations Value Chain⁶⁰

Notes

¹ William C. Pollard, *The Soul of the Firm* (Grand Rapids, MI: Harper Business and Zondervan Publishing House, 2006), 123.

² Office of Force Transformation, *Implementation of Network-Centric Warfare* (Washington, DC: Government Printing Office, 2005), 4.

³ *Ibid.*, i.

⁴ National Defense University, *Transforming America's Military*, ed. Hans Binnendijk (Washington, DC: National Defense University Press, 2002), xvii.

⁵ *Ibid.*, xix.

⁶ Robert D. Worley, *Shaping U.S. Military Forces: Revolution or Relevance in a Post-Cold War World* (West Port, CT: Praeger Security International, 2006), 22.

⁷ *Ibid.*, 23.

⁸ Mark D. Mandeles, *The Future of War: Organizational Structures for the Revolution in Military Affairs* (Dulles, VA: Potomac Books, Inc., 2005), 99.

⁹ Office of Force Transformation, 12.

¹⁰ Strategic Studies Institute and Kevin Reynolds, *Defense Transformation: To What, For What?* (Carlisle, PA: U.S. Army War College, 2006), 37.

¹¹ International Institute for Strategic Studies and Paul T. Mitchell, *Network Centric Warfare Coalition Operations in the Age of US Military Primacy* (Adelphia Paper no. 385, London, UK: Routledge, 2006), 32 - 34.

¹² Worley, 24.

¹³ *Ibid.*, 28.

¹⁴ Benjamin S. Lambeth, *The Transformation of American Air Power* (Ithaca, NY: Cornell University Press, 2000), 12-14.

¹⁵ *Ibid.*, 2.

¹⁶ Worley, 28.

¹⁷ Mandeles, 203.

¹⁸ Worley, 23.

¹⁹ Ibid., 171.

²⁰ Mandeles, 90.

²¹ David Schmidtchen, "Network-Centric Warfare: The Problem of Social Order" (Working paper no. 125, Australia: Land Warfare Studies Centre, June 2005), 9-10.

²² Mandeles, 114.

²³ Ibid., 114.

²⁴ Headquarters U.S. Marine Corps, *Command and Control*, MCDP 6 (Washington, DC: Headquarters, U.S. Marine Corps, 1996), 35.

²⁵ David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2nd ed. (Washington, DC: DOD C4ISR Cooperative Research Program, February 2000), 81.

²⁶ Mandeles, 127.

²⁷ Office of Force Transformation, 7.

²⁸ Ibid., 10.

²⁹ Ibid., 10.

³⁰ Ibid., 16.

³¹ Mandeles, 134.

³² Ibid., 134.

³³ Ibid., 111-113.

³⁴ Schmidtchen, 43.

³⁵ Alan D. Davis, "Filtering and Trust As Tools for the Operational Commander in the Information Age" (Research paper, U.S. Naval War College, 2006), 8.

³⁶ Mandeles, 132.

³⁷ Ibid., 132.

³⁸ Ibid., 108.

³⁹ Ibid., 97.

⁴⁰ Alberts et al., 80.

⁴¹ Mandeles, 134.

⁴² Ibid., 137.

⁴³ Alberts et al., 75-82.

⁴⁴ Mandeles, 148.

⁴⁵ Ibid, 169.

⁴⁶ Edward A. Smith Jr., *Complexity, Networking, and Effects-Based Operations*, (Washington, DC: DOD CCRP, July 2006), 188.

⁴⁷ Simon R. Atkinson and James Moffat, *The Agile Organization: From Informal Networks to Complex Effects and Agility* (Washington, DC: DOD CCRP, May 2005), 118.

⁴⁸ Headquarters U.S. Marine Corps, *Marine Corps Operations*, MCDP 1-0 (Washington, DC: Headquarters, U.S. Marine Corps, 2001), 2-2.

⁴⁹ Schmidtchen, 10.

⁵⁰ Ibid., 35.

⁵¹ Ibid., 8.

⁵² Mandeles, 106.

⁵³ Headquarters U.S. Marine Corps, *Leading Marines*, FMFM 1-0 (Washington, DC: Headquarters, U.S. Marine Corps, 1995), 74.

⁵⁴ Alberts et al., 103-104.

⁵⁵ Mandeles, 114.

⁵⁶ Defense Science Board, *2006 Summer Study on Information Management for Net-Centric Operations* (Washington, DC: Defense Science Board, 2007), 19-20.

⁵⁷ Ibid., 18.

⁵⁸ Mandeles, 202.

⁵⁹ Office of Force Transformation, 21.

⁶⁰ Richard B. Price, “Impact of Information Technology-for Strategic Leaders,” (Master’s thesis, U.S. Army War College, 2007), 4.

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